

Letters to the Editor: Announcement of Available Normalisation Data

LCA Normalisation Factors for the Netherlands, Western Europe and the World

Lauran van Oers and Gjaltp Huppes

Centre of Environmental Science Leiden University, Einsteinweg 2, 2300 RA Leiden, The Netherlands; e-mail: oers@cml.leidenuniv.nl

Normalisation is an optional step in the procedure involving the Life Cycle Assessment of products (LCA). In normalisation, the outcomes (characterisation scores) of a set of impact categories for alternative product systems are related to a reference situation. In general terms, the aim of normalisation in LCA is to firstly improve interpretation, and secondly provide a starting point for a subsequent weighing step if this is made.

In the International Journal of LCA, Gregory Norris (Norris 2001) made an argument for congruence in normalisation, especially in relation to the subsequent type of validation. In his paper, a distinction was made between internal and external normalisation. The purpose of the internal method is to obtain comparable scales and to resolve non-commensurate units between impact categories. In general, the reference for this internal type of normalisation is based on the characterisation scores of one of the alternatives. An important problem, as also stated by Norris, is that weighting factors need to be redefined and interpretation needs to be re-adjusted each time there is a new reference alternative (thus, for each case or for each addition of an alternative to a case).

To tackle this problem and allow for case independent weighing factors, the normalisation reference has to be case independent. Recently, a project has been carried out by CML¹ and IBED², commissioned by RIZA³ and CML, to derive such a set of external normalisation references (Oers et al. 2001).

The aim of the external normalisation set is fourfold:

- To obtain comparable scales between impact categories
- to provide a rough error check of the characterisation results
- to facilitate the interpretation of the characterisation results by expressing the impact as a 'share' to a total environmental problem in a reference region-time period
- to provide a case independent basis for a generic, formalised weighing procedure based on subjective judgements of the importance between environmental problems.

The aim of the project was to supply a broadly usable set of operational normalisation data for use in LCA. The reference value is based on the total impact per impact category for a geographical region over a period of time.

Environmental intervention data (emissions, extractions, radiation and land use) are provided for four different reference situations:

- The Netherlands, 1997/1998
- Europe, 1995
- The World, 1995
- The World, 1990.

The total impact per category for the reference situation, the normalisation factor, is calculated as the sum product of the characterisation factors and the accompanying interventions in the region-time period. Many characterisation models are available to calculate characterisation factors. The characterisation factors used in this project are taken from the proposed new factors presented in the Dutch LCA Guide (Guinée et al. 2001, forthcoming). The basic intervention data, however, can be used to establish normalisation factors for other characterisation models as well. Normalisation factors are calculated for 10 impact categories:

- abiotic depletion of resources
- global warming
- stratospheric ozone depletion
- photochemical ozone creation
- acidification
- eutrophication
- human toxicity
- ecotoxicity (5x)
- radiation
- landuse

Although much effort was spent to collect intervention data from literature for the different reference situations, extrapolation methods had to be used for some emissions in Western Europe and the World. A combination of several extrapolation techniques was used to derive missing emissions for Western Europe and the World, namely extrapolation based on:

- emission factors and the level of specific economic activities for emissions of NH₃, NO_x, SO₂, and carcinogenic PAHs for the world in 1995
- population number, livestock and the consumption of fertilisers and pesticides for emissions of N and P to water and soil, and of heavy metals and pesticides to soil
- Gross Domestic Product (GDP) as an indicator for economic activities, assuming a correlation between emissions and the GDP of the region.

For each reference situation, three types of normalisation factors are given; yearly totals, totals per \$ and totals per inhabitant. In the report, guidelines are given for the applicability of the specific references for specific analysis.

For each normalisation factor, a contribution analysis is performed indicating the most dominant interventions per impact category. The main outcome is that a limited set of emissions dominate the normalisation factor in all cases. This, in fact, is also a matter of concern, because this implies that the lack of substances (characterisation factors and/or emissions) may have such an overwhelming influence on the level of the normalisation factor.

Concluding this project has provided some basic data on environmental interventions which are adequate for the purpose of normalisation. However, lacking data and possibly inadequate characterisation models are a matter of concern and should have a prime focus in future studies.

To make a broad use of basic data possible, to establish a basis for sensitivity analysis and to provide a basis for future updates of the data, both interventions and characterisation factors are made available in a spreadsheet. The spreadsheet can be downloaded from the CML website (<http://www.leidenuniv.nl/cml/lca2/index.html>). Information on goals and choices on normalisation, used methods for data collection and discussion and conclusions of the results can be found in the accompanying report 'LCA normalisation factors for the Netherlands, Europe and the World' (Oers et al. 2001), which can be ordered at a cost of 45 at the CML website or CML library (e-mail: Eroos@cml.leidenuniv.nl).

References

- Guinée JB (final editor) (2001 forthcoming): Gorree M, Heijungs R, Huppes G, Kleijn R, Oers L van, Wegener Sleeswijk A, Suh S, Udo de Haes HA, Bruijn JA de, Duin R van, Huijbregts MAJ (eds). Life cycle assessment: An operational guide to the ISO standards. CML, Leiden University, Leiden, The Netherlands. Parts available at <http://www.leidenuniv.nl/cml/lca2/index.html>
- Oers L van (final editor) (2001): Huijbregts M, Huppes G, Koning A de, Suh S (eds). LCA normalization data for the Netherlands 1997/1998, Western Europe 1995 and the World 1990 and 1995. RIZA Lelystad and CML, Leiden University, Leiden, The Netherlands (data downloadable from <http://www.leidenuniv.nl/cml/lca2/index.html>)
- Norris GA (2001): The Requirements for Congruence in Normalization. Int J LCA 6 (2) 85-88

¹ Centre of Environmental Science, Leiden University

² Institute for Biodiversity and System Dynamics, Faculty of Science, University of Amsterdam

³ Institute of inland water management and waste water treatment